# HORIZONTAL OSCILLATOR FOR TRANSISTORIZED TELEVISION SET

by Larry Blaser and Hermann Ebenhoech

## INTRODUCTION

The horizontal frequency of 15.750 KHz is derived from an oscillator which can be built to several configurations. This paper presents a description and the performance of this multivibrator oscillator.

## THE CIRCUIT

The multivibrator oscillator circuit is shown in Fig. 1. Conventional multivibrator designs employ the capacitance in some form of collector-to-base connection. However, in this design, based on work by Foglesong[1] and by Beneteau and Evangelisti[2], the capacitance is connected between the emitters of $Q_1$ and $Q_2$. The operation is as follows: During time $T_1$, we assume $Q_1$ turned off and $Q_2$ conducting. The equivalent circuit for this period of time can be sketched as in Fig. 2.

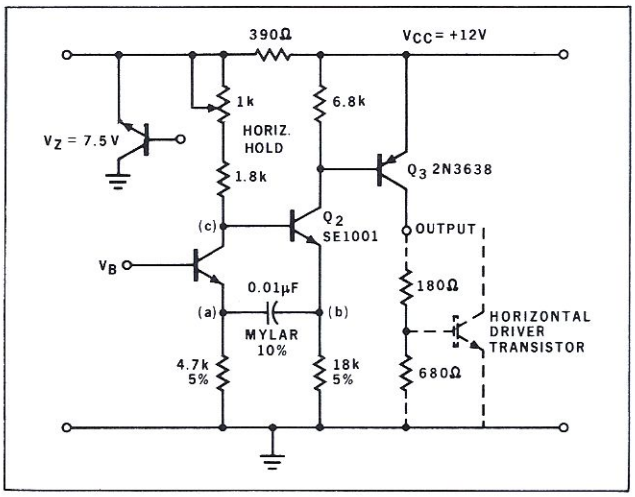


Fig. 1. Actual circuit of horizontal multivibrator oscillator.

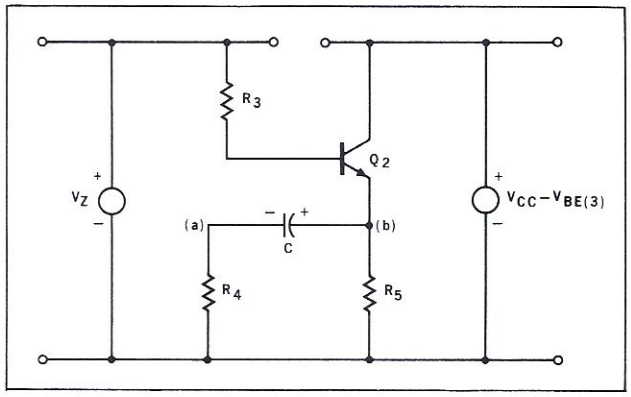


Fig. 2. Equivalent circuit during time $T_1$.

At the preceding change of states, the potential at (a) in Fig. 1 and Fig. 2 was increased above the voltage $V_B$ at the base of $Q_1$. During the time $T_1$, this voltage drops until it is lower than $V_B$ by the base-to-emitter voltage, $V_{BE(1)}$ of $Q_1$ at turn-on. $Q_1$ starts conducting and the multivibrator changes states.

The equivalent circuit for the time $T_2$ is given in Fig. 3. Point (a) is held at constant voltage by the base-to-emitter voltage, $V_{BE}$, of $Q_1$.

1. See references at end of this bulletin.

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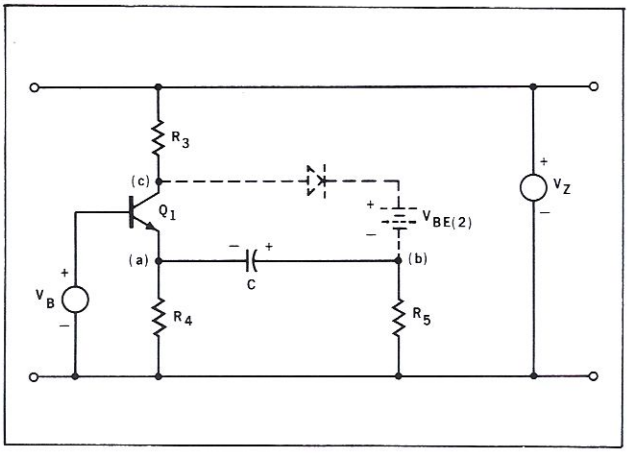


Fig. 3. Equivalent circuit during time $T_2$.

Point (b) has initially a higher potential than point (c). The capacitor, however, discharges, thus lowering the potential at (b) and increasing the one at (c) until the difference between these two potentials is equal and opposite to the base-to-emitter voltage, $V_{BE(2)}$, of $Q_2$ at turn-on. This condition starts the cycle anew. The common emitter amplifier, $Q_3$, controls the horizontal driver stage.

The curves of the voltages at (a), (b), (c) and at the output are given as $e_a$, $e_b$, $e_c$ and $e_{out}$ in Fig. 4. It will be noted that transistors $Q_1$ and $Q_2$ do not reach saturation.

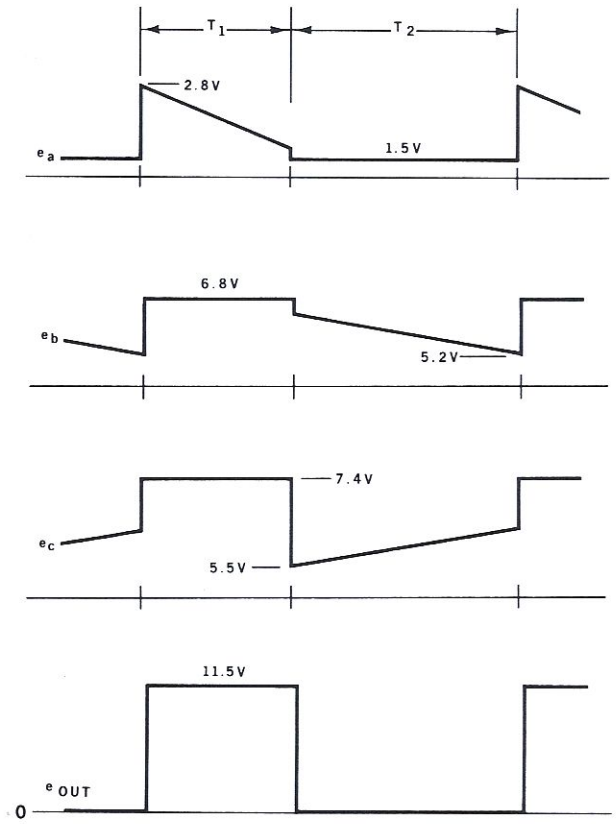


Fig. 4. Waveforms.

This is done to provide a high input impedance into $Q_1$. The step at the end of the sloped portion of $e_a$ and the corresponding step on the curve of $e_b$ are caused by the difference in $V_{BE}$ between the instant the transistor starts to conduct and the time that the change of state is completed.

## PERFORMANCE

Performance curves over the expected operating temperature range of +25°C to +75°C taken on the test circuit of Fig. 5 are shown in Fig. 6. The deviation of frequency

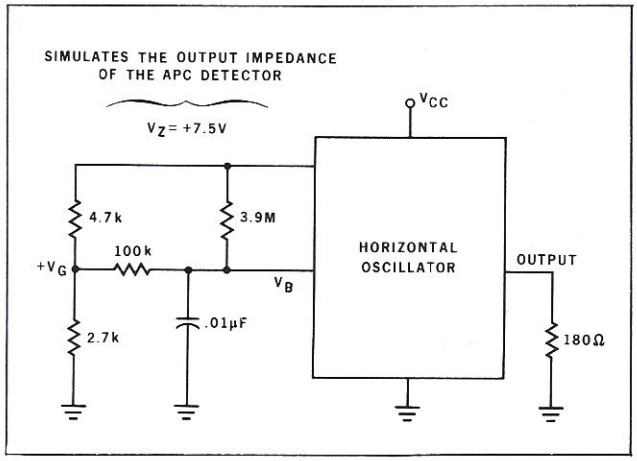


Fig. 5. Horizontal oscillator test circuit.

with temperature for each beta is less than 0.5 percent. In Fig. 6, the values for beta are the two limit values and one typical value for the SE4002.

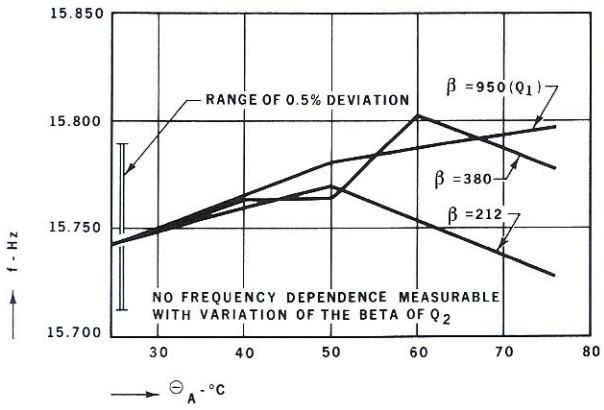


Fig. 6. Frequency versus temperature.

The frequency dependence on supply voltage is given in Fig. 7. Total frequency shift is less than 15 Hz for a supply change of +10 volts to +14 volts.

The horizontal hold control has a range from 12,600

hertz to 19,200 hertz, which is wide enough to compensate for the variations due to circuit component tolerances.

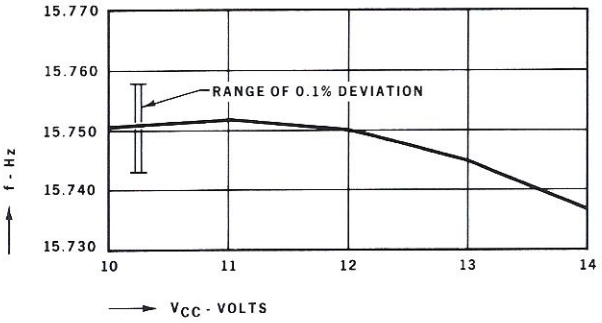


Fig. 7. Frequency versus supply voltage.

The sensitivity of the oscillator has been measured as 2300 hertz per volt. At 15,750 hertz (period = 63.5$\mu$sec) time $T_1$ is equal to 23.5 microseconds and time $T_2$ is equal to 40 microseconds.

The current drain is 34 mA at $V_{cc}$ equal to 12 volts.

## REFERENCES


1) R. L. Foglesong, "Current Switching Astable Multivibrators", Electronic Equipment Engineering, Circuit Design No. 34, p. 41, December 1961.

2) P. J. Beneteau and A. Evangelisti, "An Improved Emitter-Coupled Mulitvibrator", Fairchild Semiconductor Application Data APP-59, February 1963.

3) L. Blaser and H. Ebenhoech, "The Design of a Transistor TV Horizontal Driver", Fairchild Semiconductor Circuit Note No. 8, August 1965.

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